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COMPARISON OF PRODUCTION COSTS FOR GRADE A AND GRADE B MILK

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Analysis of 1974 survey data for 465 sample dairy farms in the Upper Midwest and southwest Missouri revealed no significant difference in the cost of producing comparable quantities per farm of grade A and grade B milk. Total costs per cow were significantly higher on grade A farms in both areas. However, higher milk production per cow on grade A farms brought average costs per hundredweight of milk produced down to near grade B cost levels.

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Summary

Minimum Class I prices (those prices for grade A milk for fluid use) in Federal milk orders are based on the Minnesota-Wisconsin price for milk for manufactured products plus a Class I differential. The Class I differential was established to offset the higher costs of producing and marketing grade A milk. The price differential, then, helps assure adequate supplies of fluid milk.

The portion of the Class I price differential which is intended to offset higher on-farm costs of producing grade A milk does not appear to be justified, according to this study of 465 Upper Midwest and southwest Missouri dairy farms. Costs of producing a hundredweight of milk were found to be about the same for comparable quantities produced on grade A and grade B farms. But the overall issue of the size of the Class I differential, which reflects any grade A/grade B cost of production difference, is too complex for complete analysis here.

Analysis of 1974 survey data for dairy farms revealed that total costs per cow were significantly higher on grade A farms. But higher per cow milk production on grade A farms brought average costs per hundredweight of milk produced down to near grade B cost levels. Higher feed, hauling, and marketing costs associated with the larger output per cow accounted for the higher grade A production costs per cow.

The study also found that farms using stanchion milking systems in the Upper Midwest had lower costs per hundredweight of milk produced than farms equipped with parlor milking systems when producing comparable quantities of milk. The type of milking system technology did not affect average costs of milk production on specialized dairy farms in southwest Missouri.

New Agency

On January 1, 1978, three USDA agencies--the Economic Research Service, the Statistical Reporting Service, and the Farmer Cooperative Service--were merged into a new organization, the Economics, Statistics, and Cooperatives Service.

COMPARISON OF PRODUCTION COSTS FOR GRADE A AND GRADE B MILK

by

David E. Cummins

Introduction

Federal milk orders [1] set minimum Class I prices (prices paid for grade A milk for fluid use) so that blend prices received by grade A producers are enough higher than prices realized by grade B milk producers to assure adequate supplies of grade A milk. The Class I price differential (Class I/Minnesota-Wisconsin manufacturing milk price differences) reflects, in part, the added costs associated with sanitation standards required for grade A production. [2] However, rising sanitation standards affecting Grade B milk production, plus the adoption of bulk milk handling technology by many grade B farmers, probably have increased the cost of producing grade B milk and narrowed the historic cost gap between the two grades of milk.

This study determines costs of producing grade A and grade B milk on selected farms in the Upper Midwest and southwest Missouri. Knowing how grade A and grade B production costs compare can help guide policymakers in decisions on the size of the Class I differential necessary to assure adequate supplies of milk. Such information can also assist grade B dairy farmers as they decide to remain grade B producers or incur the additional costs associated with grade A production.

Total milk production costs vary widely among individual farms within a "homogeneous" production area because of variation in resource prices and productivity. Costs of complying with grade A sanitation standards also vary among milk markets. Such variation makes it extremely difficult to isolate and measure the additional costs required for the production of grade A milk. This study considers simultaneously all costs of milk production incurred by actual dairy farms producing grade A and grade B milk. It then compares them. The null hypothesis of this study is that no significant difference existed in the cost of producing comparable levels of output on grade A and grade B farms.

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[1] A Federal milk marketing order is a legal instrument issued by the Secretary of Agriculture under authority of the Agricultural Marketing Agreement Act of 1937 which, in part, requires milk processors to pay at least specified minimum prices for Class I milk.

[2] Regulation requirements include separate milk housing for cooling and storing milk and for cleaning utensils; specific barn, water supply, and lighting conditions; and a minimum level of dairy herd health.

Sample Farms Studied

Data reported in this study are for 362 grade A and 103 grade B dairy farms representing production units ranging from 20 to 500 milk cows. The farms are located in the Upper Midwest (primarily Minnesota and Wisconsin) and southwest Missouri. A detailed description of the sampling procedure used is contained in USDA's 1974 dairy cost of production (COP) study. 3/ Selected characteristics of both types of producers and both areas are presented in table 1.

Grade A farms in both areas had larger herds on average, realized significantly higher levels of production per cow and per farm, and had larger farms than did grade B farms. Cropland accounted for a larger proportion of total land operated on grade A farms than on grade B farms in both areas. The total land owned compared with total land operated was about the same for all groups of producers. Despite the large variations in herd size, output per cow, and production per farm within both grade groups, the grade A and grade B farms studied represent separate populations. Relatively few grade A farms were in the smaller size groups, while most of the grade B farms were in the smaller size groups. Both groups of producers in both areas were highly specialized in the production of milk; most animal units (AU's) were dairy and a high proportion of total farm cash receipts was generated by the dairy enterprise (table 1).

Grade A dairy farms in the Upper Midwest showed a higher incidence of labor-saving technology than did grade B farms; the difference was considerably less in southwest Missouri (table 1). Virtually all producers in the sample had a bulk tank in 1974, but the incidence of a parlor milking system related more to area than to grade of milk. The majority of both grade A and grade B producers in the Upper Midwest operated with a stanchion milking facility in 1974, and all reported some type of substantial housing facility for the herd. In contrast, 80 percent of the grade A and 42 percent of the grade B farms in southwest Missouri had a parlor milking system. Housing is not as critical in this area as in the colder northern area; 59 and 62 percent of the grade A and grade B farms, respectively, indicated minimal housing for the dairy herd. There was substantially lower investment in farm buildings per milk cow in southwest Missouri than in the Upper Midwest.

The Procedure Used

Several cost functions were estimated using selected cost and structural data. The type of function giving the best fit was $Y = aX^b$. This function allowed for a rapid decline in costs per hundredweight (cwt.) of milk for lower levels of output, then declined at a decreasing rate as

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3/ Economic Research Service, U.S. Department of Agriculture. Costs of Producing Milk in the United States-1974. Washington, D.C.: Committee on Agriculture and Forestry, U.S. Senate (U.S. Govt. Print. Off.), June 11, 1976.

Table 1--Selected characteristics of grade A and grade B milk producers, study areas, 1974

Item	Unit	Upper Midwest 1/		Southwest Missouri 2/	
		Grade A	Grade B	Grade A	Grade B
Sample farms	Number	223	139	79	24
Average cows per farm ($\bar{X}$)	do.	49.2	34.8	61.6	36.4
Range	do.	20.5-255.0	19.5-99.0	20.0-175.0	19.5-69.0
Standard deviation (S_x)	do.	25.9	12.2	33.2	12.1
Average cows milked per farm ($\bar{X}$)	do.	41.5	29.2	51.0	29.0
Dairy production per farm ($\bar{X}$) 3/	Pounds	626,745	396,343	713,716	324,650
Range	do.	163,887- 2,716,963	126,539- 1,277,752	182,318- 1,845,674	139,691- 617,937
Standard deviation (S_x)	do.	329,984	178,597	395,935	134,040
Milk production per farm	do.	559,461	344,649	649,658	296,329
Farms had:					
Stanchion milking facility	Percent	87.0	94.2	20.3	58.3
Parlor milking facility	do.	13.0	5.8	79.7	41.7
Stanchion milking and housing only	do.	76.2	79.9	1.3	0.0
Parlor milking and loose or covered housing only	do.	13.0	5.8	36.7	20.8
Stanchion milking and minimal housing	do.	0.0	0.0	17.7	41.7
Parlor milking and minimal housing	do.	0.0	0.0	41.8	20.8
Bulk tank	do.	100.0	92.0	100.0	100.0
Cans	do.	0.0	8.0	0.0	0.0
Milk price per hundredweight	Dollars	7.84	7.30	8.02	7.61
Milk production per cow, yearly average	Pounds	11,395	9,927	10,546	8,141
Range	do.	5,425- 16,806	5,384- 17,709	5,688- 21,781	3,507 11,637
Standard deviation (S_x)	do.	2,309	2,265	2,818	2,229
Milk production per cow milked, yearly average	do.	13,469	11,820	12,738	10,218
Total land operated per farm	Acre	311.8	283.3	394.1	248.6
Owned	do.	228.2	209.3	300.8	183.7
Owned	Percent	73.2	73.9	76.3	73.9
Total cropland per farm	Acre	226.2	188.6	148.4	85.6
Of total operated	Percent	72.5	66.6	37.7	34.4
Crop acres per cow on farm	Acre	4.61	5.43	2.41	2.35
Total animal units per farm	Number	71.7	51.3	93.6	52.0
Dairy animal units	Percent	91.9	88.4	84.2	85.4
Total cash receipts per farm	Dollars	55,691	34,181	60,307	26,313
Dairy enterprise	Percent	86.9	82.9	93.7	91.9
Milk sales only	Percent	77.4	71.9	85.0	83.8

1/ Includes the 1974 dairy cost of production regions: NC-2, NC-5 and GP-7, NC-6, NC-7, NC-8, and NC-15 (see text footnote 3).

2/ Region NC-14 from the 1974 dairy cost of production study (see text footnote 3).

3/ Includes all milk produced plus sales of dairy cattle and calves converted to milk equivalents by dividing total dairy livestock sales receipts by the average annual milk price received as reported by the dairy farmer.

output increased. This conforms to empirically derived long-run cost curves. The b coefficient in the above function (associated with output) is the percentage change in total cost per cwt. associated with a 1 percent change in production.

All cost functions were estimated using data representing only the dairy enterprise. 4/ Expressed in logs:

$\text{Log } Y = \text{Log } A + b \text{ Log } X + C1\ D_1 + C2\ D_2$, where:

Y = total cost per cwt. of milk equivalents, 1974
X = total production of milk equivalents per farm in cwts., 1974

D_1 = grade of milk dummy $<$ 0 if farm produced grade B milk
1 if farm produced grade A milk

D_2 = technology dummy $<$ 0 if farm had a milking parlor
1 if farm had stanchion milking

A brief description of each variable follows.

Total Cost (Y)

Total costs included all costs related to the dairy enterprise that were incurred only because dairy cows were maintained (direct costs) plus the dairy enterprise's proportionate share of management and overhead that could not be meaningfully associated directly with a specific enterprise. Direct costs included the variable costs of purchased or of producing feed, veterinary and medicine expenses, fuels and lubricants, and dairy enterprise labor and fixed costs such as interest and replacement costs for power and machinery items, farm structures, and milking equipment. Determination of direct costs, except for pricing unpaid labor, posed no problems because input prices and quantities were readily available. All labor, including operator and family, used on each farm in 1974 was charged at the weighted average rate paid hired labor on that farm. If no labor was hired on the farm, the weighted average wage rate for the area was used.

Several different total cost estimates were considered in this analysis. Thus, special mention should be made of the two cost categories, feed and land, that were responsible for the different total cost estimates. 5/ Most grains and forages fed on farms producing milk in the study areas were homegrown. Feed purchased was normally limited to commercial mixed feeds, feed supplements, and other minor feed items. All such feeds were valued at their purchase cost. Feeds produced on the farm

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4/ Most of the dairy farms were highly specialized in the production of milk (table 1).

5/ For a detailed discussion of the cost concepts and procedures used in this study, see Economic Research Service, op cit., p. 5-8.

were valued at the cost of producing that feed on that farm. Land was priced at its average acquisition value. [6] The land cost was computed by multiplying the Federal Land Bank interest rate for the district in which the individual dairy farm was located times each value for land considered.

Dairy Output (X)

Dairy enterprise production has two components: (1) all milk produced by the milking herd and (2) sales of cattle and calves for meat and breeding. Because allocation of costs between these two products is impractical, receipts from dairy livestock sales were converted to milk equivalents and combined with the milk produced. [7] The combined output, expressed in cwts., is the milk equivalent production of the dairy enterprise. [8] The underlying assumption of this method is that costs are proportional to income for all products of a multiproduct enterprise.

Dummy Variables (D_1 and D_2)

Two dummy variables were included in the initial specification of the regression model: one to distinguish between the two grades of milk (D_1), and one to reflect differences in milking technology (D_2). Most dairy cows in the study areas were milked and housed in a stanchion facility. The parlor milking system is typically accompanied by a type of loose or covered housing, or even no housing in some cases.

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[6] See Economic Research Service, op cit., p. 19, for a description of the procedure used to determine average acquisition value.

[7] Dairy cattle and calves receipts were converted to milk equivalents for each farm by dividing the receipts by the average annual milk price per hundredweight received as reported by the dairy farmer.

[8] This was the figure divided into the total cost estimates to create the values for the dependent variable Y.

Results

Cost functions for two areas, the Upper Midwest and southwest Missouri, were estimated for this study. The final estimated equations 9/ for the Upper Midwest (1) and southwest Missouri (2) are:

$$(1)\ \text{Log } Y = 1.51743 - \underset{(0.02483)}{0.15166^{**}}\text{Log } X + \underset{(0.01027)}{0.01141}D_1 - \underset{(0.01577)}{0.0309^{*}}D_2 \text{ and}$$

$$(2)\ \text{Log } Y = 1.35178 - \underset{(0.04494)}{0.11106^{*}}\text{Log } X + \underset{(0.02590)}{0.02009}D_1 + \underset{(0.02335)}{0.0186}D_2$$

The cost coefficients in equations (1) and (2) are significant at the 1-(**) and 5-(*) percent levels of probability. The numbers in parentheses below the coefficients are their respective standard errors. The relationship between unit cost of production and level of output is significant for both areas, and shows declining average total costs over the range in output represented by the sample farms. Regression analysis also revealed that, for both areas, there was no significant difference in the cost of producing comparable quantities of output on grade A and grade B dairy farms. Adjusting for farm firm size (measured as total milk equivalents produced per farm) is important because the size distributions of both groups of grade A producers are shifted to the right of the corresponding size distributions of the grade B producers. Although the difference was not significant at the 5-percent level for either area, total production costs per cwt. actually averaged higher on the grade B than on the grade A dairy farms in both areas: $0.27 in the Upper Midwest and $0.29 in southwest Missouri. This is because the grade B farms tended to be smaller and had lower yielding cows.

There is no single cost of producing milk. Considerable variation underlies any average cost figure for even a group of similar producers (see tables 2 and 3). Probably the most important factor underlying variation in costs is management, the quality of which is reflected, in part, by milk cow productivity. Milk production per cow tended to fall off with an increase in per cwt. cost levels (tables 2 and 3). Regression analysis showed that increasing milk production per cow 1 percent, while holding herd size constant, resulted in a decrease in average total costs per cwt. of 0.39 percent for the Upper Midwest farms and 0.34 percent for the southwest Missouri farms. 10/

9/ Other types of functions tested for goodness of fit included semi log, linear, and curvilinear with a square root term. Equations also were fitted for only the grades A and B farms in each area that fell within a common herd size range. Results for the full samples are presented in this study because the critical coefficient values are sufficiently close to, and the conclusions the same as, those for the restricted range samples.

10/ Both regression coefficients are significant at the 1-percent level. The herd size coefficient was not significant at the 50-percent level in both cases.

Table 2--Upper Midwest distribution of dairy farms and milk production and other selected statistics, 1974

Cost per cwt. of milk produced	Upper Midwest--Grade A 1/							Upper Midwest--Grade B 1/						
	Percent of:		Milk price Per cwt.	Total cost per cwt. 2/	Profit or loss 3/	Milk cows per farm	Milk equiv. per cow 4/	Percent of:		Milk price per cwt.	Total cost per cwt. 2/	Profit or loss 3/	Milk cows per farm	Milk equiv. per cow 4/
	Farms	Production						Farms	Production					
Dollars	--- Pct. ---		---- Dollars ----			No.	Lbs.	-- Pct. --		---- Dollars ----			No.	Lbs.
<6.50	6.7	8.0	7.70	6.06	1.64	49.1	15,144	4.3	6.8	6.87	5.16	1.71	41.9	14,833
6.50 - 6.99	7.2	7.4	7.82	6.72	1.10	44.5	14,562	6.5	7.1	7.06	6.76	.30	31.6	13,750
7.00 - 7.49	13.0	14.0	7.64	7.26	.38	50.4	13,359	10.1	11.3	7.21	7.21	.00	37.1	12,024
7.50 - 7.99	8.5	9.5	7.94	7.83	.11	51.3	13,625	12.2	12.6	7.03	7.70	-.67	33.9	12,082
8.00 - 8.49	14.8	16.4	7.80	8.26	-.46	54.3	12,769	11.5	12.1	7.29	8.21	-.92	34.8	11,938
8.50 - 8.99	10.3	9.0	7.83	8.72	-.89	42.1	12,983	11.5	11.6	7.34	8.68	-1.34	35.3	11,308
9.00 - 9.49	8.5	8.3	7.82	9.19	-1.37	49.2	12,478	10.8	9.9	7.59	9.19	-1.60	32.9	11,069
9.50 - 9.99	10.8	9.7	7.84	9.75	-1.91	44.5	12,683	5.8	5.2	7.51	9.83	-2.32	35.2	10,238
10.00 - 10.49	5.4	4.7	8.05	10.16	-2.11	48.1	11,440	4.3	3.7	8.00	10.30	-2.30	36.7	9,142
10.50 - 10.99	4.5	5.0	8.05	10.62	-2.57	66.1	10,639	6.5	4.0	7.29	10.85	-3.56	25.3	9,589
11.00 plus	10.3	8.0	8.06	12.12	-4.06	46.8	10,360	16.5	15.7	7.38	12.70	-5.32	37.3	10,089
Total or weighted avg.	100.0	100.0	7.84	8.57	-0.73	49.2	12,750	100.0	100.0	7.30	8.84	-1.54	34.8	11,394

1/ See table 1, footnote 1.

2/ Homegrown feed is valued at its cost of production and land is priced at its acquisition value.

3/ Simply the difference between milk price and total cost per cwt.

4/ Includes all milk produced plus sales of dairy cattle and calves converted to milk equivalents by dividing total dairy livestock sales receipts by the average annual milk price received as reported by the dairy farmer.

Table 3--Southwest Missouri distribution of dairy farms and milk production and other selected statistics, 1974

Cost per cwt. of milk produced	Southwest Missouri--Grade A 1/							Southwest Missouri--Grade B 1/						
	Percent of:		Milk price per cwt.	Total cost per cwt. 2/	Profit or loss 3/	Milk cows per farm	Milk equiv. per cow 4/	Percent of:		Milk price per cwt.	Total cost per cwt. 2/	Profit or loss 3/	Milk cows per farm	Milk equiv. per cow 4/
	Farms	Prod-uction						Farms	Prod-uction					
Dollars	--- Pct. ---		---- Dollars ----			No.	Lbs.	--- Pct. ---		---- Dollars ----			No.	Lbs.
<6.50	7.6	6.3	7.09	6.21	0.88	46.2	12,720	0.0	---	---	---	---	---	---
6.50 - 6.99	6.3	7.6	7.31	6.81	.50	60.1	14,180	4.2	5.9	7.71	6.75	0.96	37.0	12,386
7.00 - 7.49	12.7	18.2	8.10	7.26	.84	77.2	13,327	0.0	---	---	---	---	---	---
7.50 - 7.99	5.0	6.2	8.30	7.72	.58	63.8	13,762	12.5	13.7	8.08	7.89	.19	35.3	10,099
8.00 - 8.49	12.7	12.0	7.89	8.22	-.33	49.1	13,791	4.2	7.0	7.40	8.01	-.61	51.5	10,535
8.50 - 8.99	10.1	8.6	8.24	8.78	-.54	59.2	10,250	8.3	10.6	8.07	8.79	-.72	35.8	11,500
9.00 - 9.49	8.9	7.5	7.99	9.21	-1.22	50.6	11,954	33.3	34.8	7.56	9.12	-1.56	38.2	8,873
9.50 - 9.99	8.9	6.0	8.11	9.78	-1.67	46.0	10,509	8.3	6.9	7.34	9.86	-2.52	25.8	10,398
10.00 - 10.49	2.5	4.0	7.89	10.33	-2.44	105.0	10,569	4.2	3.2	7.59	10.24	-2.65	69.0	7,214
10.50 - 10.99	5.0	5.6	8.71	10.75	-2.04	78.0	10,180	0.0	---	--	--	---	---	---
11.00 plus	20.3	18.0	8.33	12.54	-4.21	68.8	9,227	25.0	17.9	7.19	11.95	-4.76	30.0	7,761
Total or weighted avg.	100.0	100.0	8.02	9.00	-0.98	61.6	11,581	100.0	100.0	7.61	9.29	-1.68	36.4	8,930

1/ See table 1, footnote 2.

2/ Homegrown feed is valued at its cost of production and land is priced at its acquisition value.

3/ Simply the difference between milk price and total cost per cwt.

4/ Includes all milk produced plus sales of dairy cattle and calves converted to milk equivalents by dividing total dairy livestock sales receipts by the average annual milk price received as reported by the dairy farmer.

An interesting byproduct of this analysis is the sign and significance level of the technology dummy variable for the Upper Midwest. Data in table 1 show that only 10 percent of the sample farms in the Upper Midwest reported operating with a milking parlor in 1974. This compares with 71 percent of the farms in southwest Missouri. This suggests that the stanchion facility is better suited to the conditions of the Upper Midwest. It also suggests that the average total cost per cwt. of producing milk tends to be lower when operating with a stanchion milking facility than with a parlor setup (including costs of any companion technology frequently adopted along with a parlor system such as loose housing, liquid manure handling, and automated feeding system). [11] This finding might indicate why widespread adoption of the milking parlor has not occurred in the Upper Midwest. [12] Many milking parlors, and the companion facilities, might have been underutilized; thus, minimum unit costs of operating these facilities were not being achieved. The technology dummy was not significant for the southwest Missouri area farms studied, probably because extensive, higher cost housing and feeding facilities which normally accompany parlor installations in the relatively cold northern areas might not be needed in the warmer climate of southwest Missouri. [13]

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[11] This exists despite the finding, using regression analysis, that in the Upper Midwest, hours of labor required to care for the dairy herd per cow reported by the survey farmers not only declined significantly with an increase in herd size but also averaged significantly lower on parlor than on stanchion farms of comparable herd size. Even though having obtained only aggregate capital investment data on the survey precludes any enlightening capital costs analysis, the findings of the labor analysis suggest that capital costs associated with the milking, housing, and feeding facilities were substantially higher on parlor than on stanchion farms of similar herd size.

[12] Although the technology dummy variable was not significant at the 5-percent level for each of the 6 dairy COP study regions forming the Upper Midwest for this study, the sign of its coefficient was always negative.

[13] Even though sufficient information was not obtained on the survey to be able to identify and value the farm structures related specifically to the dairy enterprise, the highly specialized nature of these survey farms does enable one to draw inferences from the aggregate data. On a per milk cow or on a dairy AU basis, the Jan. 1, 1974, value of the farm structures on both grade A and grade B farms averaged at least 50 percent higher in the Upper Midwest than in southwest Missouri. This reflects, in part, the observation that 60 percent of the southwest Missouri farms reported only minimal housing for the milk cows.

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